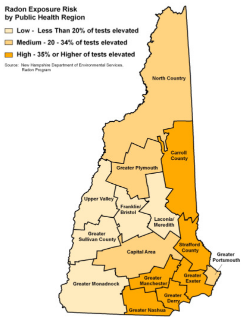
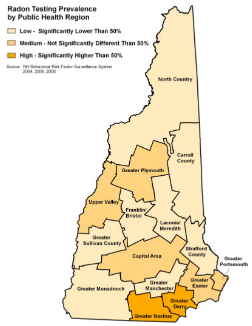
The Contribution of the Behavioral Risk Factor Surveillance System (BRFSS) to Radon Surveillance in New Hampshire, Susan Knight, John Colby, NH DHHS





Background

Radon definition

Radon is a naturally occurring radioactive gas commonly found in bedrock and water across the U.S. Radon is found more commonly in some areas of the U.S., including in New Hampshire (the "Granite State"). If present in the surrounding bedrock, radon can enter homes, primarily through cracks in the foundation or by being released from household water. (1)

Health Effects

§ Lung cancer is the health effect most commonly resulting from radon exposure. The EPA estimates that radon causes more than 20,000 lung cancer deaths per year. (2)

§ Cigarette smoking and radon exposure together further increase risk of lung cancer. (2)

§ Children may also be at greater risk from exposure compared to adults. (2)

Mitigation

§ The recommended maximum level of radon in indoor air is 4 picocuries per liter (pCi/L). of indoor air. In New Hampshire, about one in three homes have radon levels above 4 Pci/L compared to one in 15 homes nationally. (1)

§ The most effective way of reducing radon exposure and risk is by venting contaminated air from under and around the foundation of the home. This method removes most radon reaching the indoor air. Cost for this system is about $1,500. (1)

§ Radon can also be removed from water before it enters the home. This is less common and more costly, approximately $2,000 to $4,000 not including maintenance costs. (1)

Data

§ The NH Department of Environmental Services (DES) radon test data were used to define geographic risk of respondents' area of residence.

§ The BRFSS is a state based system of telephone surveys of adults aged 18 or older, not living in group quarters or institutions. BRFSS is supported by funding and technical assistance from the Centers for Disease Control and Prevention (CDC). The purpose of the BRFSS is to provide state-level estimates of health behaviors and health conditions. The BRFSS questionnaire consists of a set of Core questions followed by Optional Modules and questions added by state programs (State Added Questions or SAQs). NH periodically adds radon questions to the SAQ area.

§ In 2005, NH BRFSS increased its sample size and modified its sample design to provide NH BRFSS results at the sub-state level for 2005 and subsequent years. This has allowed results of radon questions to be examined for areas of the state where radon exposure potential is higher.

Methods

- In 2004, 2006 and 2008, NH added six radon questions to the end of the annual BRFSS questionnaire. Data from these three years were combined to increase power for the analysis.
- All respondents were asked if they had "heard of radon" and those responding 'Yes" to this question were also asked if they could define radon and its health effects.
- High risk of radon exposure was defined in two ways.
- First, survey respondents reporting they resided in a single or multi-family house or condominium with living space below the third floor; or a basement, 1st or 2nd floor or floor apartment; or manufactured housing with a permanent foundation were considered at risk of exposure and asked follow-up questions regarding testing and venting.
- Second, NH's Public Health Regions (PHRs) were ranked according to geographic potential for radon exposure. Data for this ranking came from radon test results provided by NH DES radon program. PHRs with 35% or more elevated radon tests results were ranked as high risk, PHRs with 20% to 34% elevated tests were ranked as medium risk and PHRs with less than 20% elevated test results were ranked as low risk.
- Third, each PHR was ranked by level of prevalence of radon testing (from NH BRFSS data 2004, 2006 and 2008). Low testing prevalence was significantly less than 50%, medium testing prevalence was not significantly different from 50% and high testing prevalence was significantly higher than 50%.
- Using SAS Survey Procedures (4), results of BRFSS radon questions were examined by socio-economic characteristics, radon awareness and geographic radon risk as well as current smoking status and presence of children in the respondent's home.

Contact info. for Susan Knight: email at sknight@dhhs.state.nh.us

Phone: 603.271.4671

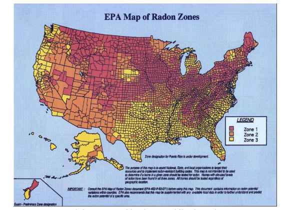
Awareness	Correctly named health condition associated with radon in air			Correctly described radon as radioactive gas		
Characteristic	**Percent**	**95% CI**	**P value for Chi Square**	**Percent**	**95% CI**	**P value for Chi Square**
Sex						
Male	41.9	40.4 - 43.4	<.0001	76.3	75.0 - 77.7	<.0001
Female	31.1	29.9 - 32.2		66.1	65.0 - 67.3	
Age			<.0001			<.0001
18 to 24	24.6	19.1 - 30.2		52.9	46.9 - 58.8	
25 to 34	31.5	28.7 - 34.3		69.2	66.6 - 71.8	
35 to 44	39.1	37.0 - 41.3		76.6	74.9 - 78.3	
45 to 54	42.1	40.2 - 44.0		77.6	76.1 - 79.2	
55 to 64	40.5	38.5 - 42.5		76.8	75.1 - 78.4	
65 or older	31.1	29.3 - 32.9		60.1	58.3 - 61.9	
Education			<.0001			<.0001
Less than High school or GED	25.8	21.4 - 30.1		39.8	35.1 - 44.4	
High School or GED	29.1	27.3 - 30.9		60.5	58.6 - 62.3	
Some college or technical school	35.3	33.4 - 37.2		70.0	68.2 - 71.8	
College graduate	42.7	41.2 - 44.2		81.8	80.7 - 83.0	
Income			<.0001			<.0001
Less than $15,000	28.9	24.8 - 33.0		51.5	47.4 - 55.7	
$15,000 to $24,999	29.3	26.3 - 32.2		54.6	51.5 - 57.8	
$25,000 to $34,999	30.2	27.1 - 33.2		64.5	61.3 - 67.6	
$35,000 to $49,999	33.6	31.1 - 36.1		67.8	65.4 - 70.2	
$50,000 to $74,999	35.9	33.7 - 38.1		76.9	75.0 - 78.8	
$75,000+	44.0	42.2 - 45.7		80.9	79.5 - 82.4	
Marital status			<.0001			<.0001
Married or unmarried couple	38.1	37.0 - 39.2		74.1	73.2 - 75.1	
Single	31.0	28.8 - 33.3		61.5	59.3 - 63.8	
Residential area risk			0.1146			0.0213
Low risk area	34.8	32.9 - 36.6		69.4	67.6 - 71.2	
Medium risk area	37.6	35.4 - 39.8		73.2	71.3 - 75.0	
High risk area	36.9	35.6 - 38.3		71.5	70.2 - 72.7	
Smoking status			<.0001			<.0001
Current smoker	31.2	28.8 - 33.6		63.7	61.3 - 66.1	
Former or never smoker	37.6	36.6 - 38.7		72.8	71.8 - 73.7	

Prevalence of reported radon testing, 2004, 2006 and 2008 NH BRFSS

Characteristic	Percent	95% CI	P value for Chi Square
Sex			0.0138
Male	48.0	46.4 - 49.7	
Female	45.4	44.1 - 46.7	
Age			<.0001
18 to 24	35.0	28.5 - 41.5	
25 to 34	52.6	49.4 - 55.7	
35 to 44	55.4	53.3 - 57.6	
45 to 54	48.7	46.8 - 50.7	
55 to 64	42.4	40.3 - 44.5	
65 or older	34.7	32.8 - 36.7	
Education			<.0001
Less than High school or GED	28.5	23.5 - 33.5	
High School or GED	37.3	35.2 - 39.4	
Some college or technical school	44.8	42.7 - 46.9	
College graduate	54.6	53.0 - 56.1	
Income			<.0001
Less than $15,000	24.3	19.2 - 29.3	
$15,000 to $24,999	30.1	26.6 - 33.6	
$25,000 to $34,999	34.2	30.7 - 37.7	
$35,000 to $49,999	37.6	34.9 - 40.2	
$50,000 to $74,999	49.5	47.2 - 51.9	
$75,000+	57.7	55.9 - 59.4	
Marital Status			<.0001
Married or unmarried couple	49.9	48.7 - 51.0	
Single	34.9	32.3 - 37.5	
Residential area risk			<.0001
Low	39.1	37.1 - 41.1	
Medium	44.7	42.3 - 47.0	
High	50.4	49.0 - 51.9	
Radon knowledge			<.0001
Both describe radon and know lung cancer effect	54.4	52.5 - 56.2	
Either can desribe radon or know lung cancer effect	47.2	45.7 - 48.7	
Do not know what radon is or health effect	35.8	33.4 - 38.2	
Smoking status			0.0002
Current smoker	44.5	42.5 - 46.5	
Former or never smoker	49.0	47.6 - 50.4	

Percent reporting radon vent installed, among those reporting an elevated test, by knowledge level and demographic characteristics, 2004, 2006 and 2008 NH BRFSS

Characteristic	Percent	95% CI	P value for Chi Square
Sex			
Male	26.6	22.0 - 31.1	0.0548
Female	33.1	28.1 - 38.0	
Age			
18 to 34	31.9	21.2 - 42.6	0.0132
35 to 44	37.8	31.2 - 44.4	
45 to 54	26.8	20.9 - 32.6	
55 to 64	24.9	18.5 - 31.3	
65 or older	20.4	13.8 - 27.0	
Education			
High school or less	21.7	13.3 - 30.1	0.0016
Some college or tech	23.2	17.5 - 28.9	
College grad	36.1	31.5 - 40.7	
Income			
Less than $35,000	11.5	5.0 - 18.0	<.0001
$35,000 to less than $75,000	23.3	16.3 - 30.3	
$75,000 or more	37.9	33.1 - 42.8	
Marital Status			
Married or unmarried couple	30.3	26.9 - 33.7	0.5343
Single	25.8	12.6 - 39.0	
Residential area risk			
Low	19.7	12.9 - 26.5	0.0168
Medium	27.5	19.6 - 35.3	
High	32.4	28.1 - 36.7	
Knowledge of radon			
Both describe radon and know lung cancer effect	38.2	32.8 - 43.6	<.0001
Either can desribe radon or know lung cancer effect	24.3	19.5 - 29.0	
Do not know what radon is or health effect	15.5	8.2 - 22.8	
Smoking status			
Current smoker	31.1	25.1 - 37.2	0.908
Former or never smoker	31.6	27.0 - 36.1	



Note: Zone definitions used by the EPA differ from those used here for New Hampshire Risk Levels

Results

Awareness

The prevalence of radon awareness was higher for:

- males compared to females,
- middle aged adults compared to adults aged 18 to 24 or those 65 or older,
- adults residing in high exposure risk areas,
- Married or unmarried couples compared to other marital status,
- Former or never smokers compared to current smokers.

Prevalence of awareness also increased with increasing:

- income, and
- educational attainment.

Testing

Among those residing in a single or multi-family house or condominium with living space below the third floor; or a basement, 1st or 2nd floor or floor apartment; or manufactured housing with a permanent foundation, the prevalence of radon testing was higher for:

- males compared to females,
- middle aged adults compared to adults aged 18 to 24 or those 65 or older,
- Married or unmarried couples compared to other marital status,

Conclusions

- General awareness of radon is high.
- However, with only 50% of adults residing in high exposure risk areas reporting testing, the prevalence of testing should be higher.
- Among adults reporting an elevated test result, only 30% reported mitigation or a "radon vent" in their home.
  - This is true even among higher risk populations such as those residing in high exposure risk areas and current smokers.
- Radon testing and mitigation is associated with both awareness and socio-economic status.
- Steps to increase both testing and mitigation might include partnering with smoking cessation programs, and identifying ways to help homeowners at higher risk with the cost of venting.
- Going forward, information on whether respondents rent or own their homes would be useful. This question has been added to the BRFSS Core.
- The radon questions will be asked again as funding allows.

References

1. NH Department of Environmental Services. Radon in Air and Water An Overview For The Homeowner, 2009. Available at: http://des.nh.gov/organization/divisions/air/pehb/ehs/radon/index.htm

2. U.S. Environmental Protection Agency. A Citizen's Guide to Radon, January 2009. Available at: http://www.epa.gov/radon/pubs/citguide.html. Accessed 2/11/11

3. Issue Brief: Radon Exposure and Testing Behavior. NH Environmental Public Health Tacking Program, Division of Public Health Services, NH Department of Health and Human Services, 2009. Available at: http://www.nh.gov/epht/index.htm. Accessed 2/17/11.

4. SAS Institute Inc. 2007. SAS OnlineDoc® 9.2. Cary, NC: SAS Institute Inc.